NITRATE-NITROGEN IMPACT ANALYSIS FOR ENGINEERED SYSTEMS

GENERAL

Background: This Appendix is not intended to be enforced as part of the code's minimum requirements. Nitrogen contamination of ground and surface waters, due to on-site disposal of waste water, may be a public health and environmental problem in some areas. A public health problem of particular concern is nitrate contamination of drinking water supplies. Ingestion of water containing concentrations greater than 10 milligrams per liter of nitrate-nitrogen can be a cause of oxygen deficiency in young infants. Of environmental concern is the fact that nitrogen may be the limiting nutrient that controls eutrophication in coastal marine waters, estuaries, and some fresh water lakes and ponds. Therefore, excess nitrogen added to a water body may enhance eutrophication resulting in algal growth and other undesirable effects.

Intent: The intent of this Appendix is to provide a simple screening method for determining whether a more site-specific modeling of the nitrogen impact should be considered for those systems handling 2,000 gpd or more. The function of the nitrogen screening analysis is to show that nitrogen leaving the disposal field should not cause nearby domestic water supplies to exceed the acceptable nitrate-nitrogen limit of 10 milligrams per liter.

NITROGEN SCREENING ANALYSIS

Procedure: The following procedure provides a simple method of determining whether a more site-specific modeling of nitrogen impact is needed.

Step 1: Determine the overall size of the property in square feet;

Step 2: Determine the design flow from Chapter 9; and

Step 3: Using the most prominent soil profile condition, multiply the design flow by figure given in Table F-1. For example, assume a property has a soil profile 6, a soil condition C, and a system design flow of 3000 gpd. Reading down the left-hand column of Table F-1 to soil profile 6 and across to soil condition C gives the figure of 78 square feet needed to dilute each gallon of waste water. Now, multiplying the design flow of 3,000 gpd by the 78 square feet gives an answer of 234,000 square feet.

This answer gives the minimum square footage of land area needed to reduce nitrate-nitrogen to an acceptable level.

TABLE F-1

Minimum square feet needed to dilute each gallon of waste water

Waste water with 40 mg/l NO_3-N

Soil profile	Soil conditions						
	AI	**AII**	**AIII**	**B**	**C**	**D**	**E**
1	112	82	82	78	82	82	112
2	112	82	78	78	78	82	112
3	112	82	82	82	82	82	112
4	112	82	78	78	78	82	112
5	112	82	78	78	78	82	112
6	112	82	78	62	78	82	112
7	112	82	82	82	82	82	112
8	112	82	82	78	82	82	112
9	112	82	82	82	82	82	112
11	112	82	78	78	78	82	112

Waste water with 20 mg/l NO_3-N.

Soil profile	Soil conditions						
	AI	**AII**	**AIII**	**B**	**C**	**D**	**E**
1	37	27	27	26	27	27	37
2	37	27	26	26	26	27	37
3	37	27	27	27	27	27	37
4	37	27	26	26	26	27	37
5	37	27	26	26	26	27	37
6	37	27	26	21	26	27	37
7	37	27	27	27	27	27	37
8	37	27	27	26	27	27	37
9	37	27	27	27	27	27	37
11	37	27	26	26	26	27	37

Questionable sites: If the square footage calculated in "Step 3," is larger than the actual square footage on the property, suggested that a site-specific nitrate impact analysis may be needed.

ASSUMPTIONS USED

General: The NO_3-N impact screening analysis is based on the assumptions in this Section.

Assumption 1: The approach is a simple mass balance model assuming shallow ground water in the "interflow" and "throughflow" regime.

Assumption 2: All the nitrogen is converted to nitrate ions in the soil within the boundaries of the property.

Assumption 3: The nitrate-nitrogen concentration of the treated waste water leaving the disposal field is assumed to be in compliance with Table F-2.

TABLE F-2

NO_3-N concentration of effluent leaving the disposal field

Disposal system type	Initial NO_3-N concentrations
Disposal field	40 mg/l
Peat-bed or filter	20 mg/l
Denitrification (e.g. "RUCK" system)	See note below

Note: Initial NO_3-N concentration is to be determined on a case-by-case basis from valid field-test data provided by the designer and/or manufacturer of the proposed denitrification system.

Assumption 4: No allowance is made for nitrogen removal by vegetation.

Assumption 5: No allowance is made for nitrogen removal by soil sorption.

Assumption 6: No allowance is made for dilution by subsurface water moving onto the site.

Assumption 7: A fraction of the annual precipitation will infiltrate the soil and be available to mix with and dilute the nitrogen in the treated waste water. That fraction depends on ground cover, land usage, hydrologic soil group, and the amount and duration of precipitation. Most of these factors will vary on any given site.

Assumption 8: Dependent on site and soil conditions, varying percentages of the treated waste water and the infiltrated precipitation are able to move down to ground water used for water supplies. The remaining portions of the infiltrating precipitation and the treated waste water tend to move down slope, parallel to the ground surface, as perched water.

Assumption 9: The annual precipitation rate is 25.2 inches per year. (This figure is 60% of the 42 inches per year average annual precipitation rate to adjust for drought years.)

Assumption 10: To dilute each gallon of waste water containing 40 milligrams of nitrate-nitrogen per liter to a desired 10 milligrams of nitrate-nitrogen per liter requires 3 gallons of infiltrating precipitation for each gallon of waste water. For a peat disposal field the assumption is that 1 gallon of infiltrating precipitation is needed for each gallon of waste water for peat disposal field effluent containing 20 milligrams of nitrate-nitrogen per liter.

Assumption 11: A certain amount of background NO_3-N exists in the ground water being evaluated. This parameter is not considered in these calculations because of the conservatism built into assumptions 4, 5, and 6.

Assumption 12: NO_3-N is contained in the precipitation that falls and infiltrates the site at an average concentration of 0.5 mg/l. This parameter is not considered because of the conservatism built into assumptions 4, 5, and 6.

Assumption 13: A certain amount of NO_3-N may be contributed by the development itself or from post-development activity (e.g., lawn fertilizer). This parameter is not considered because of the conservatism built into assumptions 4, 5, and 6.

Assumption 14: Since the nitrate plume may or may not disperse and its width and direction are difficult to predict therefore it is assumed that any precipitation falling on the property may be available for diluting the waste water.

Assumption 15: A certain percentage of the annual precipitation will infiltrate and recharge the soil. This will be available to mix with and dilute NO_3-N as determined by the type of surficial geologic deposits, or by the hydrologic soil group as defined by the U.S. Soil Conservation Service. Used together, Table F-3 and Table F-4 give the percentage of infiltration for each soil group. Note: The percentage of the infiltrating water that reaches the permanent ground water table is in the range of 5% to 20%.

First, read down the side of Table F-3 and find the appropriate soil profile. Then read across to the column for the appropriate soil condition. For example, for a soil profile 4 and a soil condition C, the hydrologic soil group is "B."

Now, using Table F-4, find the slope of the land down the left- hand column. Then read across to the hydrologic soil group to find the annual infiltration rate. For example, for a slope of 8-15% and a hydrologic soil group "B," the annual infiltration rate is 0.024 gallons per day for each square foot of area.

TABLE F-3

Hydrologic soil groups vs soil profile and soil conditions

Soil profile	**Soil Conditions**						
	AI	**AII**	**AIII**	**B**	**C**	**D**	**E**
1	D	D	C	C	C	C	D
2	D	D	C	B	B	C	D
3	D	D	C	C	C	C	D
4	D	C	C	B	B	C	D
5	D	C	C	B	B	C	D
6	D	C	C	A	B	C	D

7	-	C	C	C	C	C	D
8	D	D	C	C	C	D	D
9	D	D	C	C	C	D	D
11	D	C	C	B	B	C	D

Note: Recharge rates for shallow upland soils that are underlain by fractured bedrock and that are designated in hydrologic soil group D, should be determined according to geologic properties, rather than by the hydrologic soil group.

Some profile conditions have dual designations (C/D,A/B,etc.) The most restrictive hydrologic group was used in preparation of this chart. (Source - Maine Soil and Water Conservation Commission with the assistance by the U.S.D.A. Soil Conservation Service)

TABLE F-4

Annual average infiltration vs hydrologic soil group

Slope	**Average infiltration**			
	Hydrologic soil group			
	A	**B**	**C**	**D**
0-8%	.036	.030	.024	.018
8-15%	.029	.024	.022	.016
16-25%	.023	.019	.019	.014
>25%	.016	.016	.016	.012